

A BOTANICAL ANALYSIS OF KIRTLAND'S WARBLER NESTS

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THE Kirtland's Warbler (*Dendroica kirtlandii*) is of special interest to ornithologists because its breeding range is restricted to the distinctive jack-pine (*Pinus banksiana*) plains of the northern part of the Lower Peninsula of Michigan. The 1951 census of this species reported by Mayfield (1953. *Auk*, 70:17-20) indicated that the total population at that time was about 1,000 individuals. The species is most common in four (Crawford, Oscoda, Iosco, and Montmorency) of the 12 counties where nests have been recorded. The breeding range of the species is less than 85 by 100 miles in size. A portion of the data accumulated during this study appeared in H. Mayfield's book, "The Kirtland's Warbler" (1960. Cranbrook Institute of Science). Data so used are indicated in this paper.

Ornithologists have been puzzled by the restriction of the Kirtland's Warbler to a portion of Michigan's jack-pine regions. Mayfield (op. cit.) suggested three interrelated factors as an answer: (1) porous soils, (2) suitable ground cover, and (3) large tracts of young jack pines. In this study I attempted to determine whether or not the materials used in the warbler's nests, since they are obtained from the ground cover, aided in restricting the species to the more open pine forest.

According to Zimmerman (MS) the jack-pine plains may be divided into three parts: (1) the forest—large, fairly dense stands of jack pine; (2) savannas—stands of open, scattered jack pines, and sometimes a few other species; (3) burns—regions in which the stands of large trees have been destroyed and natural reforestation is taking place. The Kirtland's Warbler nests only in savannas and burns. Therefore, only the vegetation of these formations is considered here.

In this study I examined 25 Kirtland's Warbler nests. Twenty of these nests were taken apart and the materials identified, when possible, and weighed. Measurements were recorded; only the 16 nests that contained eggs were used in computing average dimensions since nests that contained young were probably stretched out of shape. During the summer of 1958, I made a botanical study of a section of Kirtland's Warbler habitat in Presque Isle County. Some of the data from that study are included in this paper.

I wish to express my appreciation to Dr. Elzada Clover, Dr. Charles Conrad, Mr. Mason Fenwick, and to Dr. Edward Voss for their assistance in the identification of plant materials. Dr. Voss also made available the University of Michigan Herbarium for comparison of specimens. All of the nests used in this study were from the collections of the University of Michigan Museum of Zoology. Dr. Dale Zimmerman and Mr. Harold Mayfield made available their manuscripts and permitted me to use pertinent information. Dr. Harrison Tordoff made valuable suggestions during the preparation of the manuscript.

The flora of the pine plains is made up of approximately 175 species of higher plants and some 15 species of lichens, mosses, and ferns. In few parts of the dry, sandy, upland pine plains are there luxuriant growths of vegetation. The coverage is much greater in some regions but it is often possible to find sand showing through the ground cover; in some localities fairly large expanses of sand supporting little besides mosses are evident.

The jack pine is the dominant tree of the pine plains but numerous oaks (*Quercus*), occasional aspens (*Populus*), some cherry (*Prunus*), and a few red pines (*Pinus resinosa*) may be interspersed. Red pine plantations are found in some localities. If deciduous trees become too numerous the warblers no longer use the habitat.

The Kirtland's Warbler appears to require an open stand of pines which allows filtered light penetration. This is best offered by stands of jack pines 6 to 15 feet high. Dense "islands" of pines usually exist with openings of herbaceous plants between. Mayfield (op. cit.) stated that the penetration of sunlight increases the life span of the lower branches and thus provides cover nearer the ground and nest. The nest of the warblers may be located on the ground within or at the edge of such an "island." The nests examined were constructed in depressions that ranged from 29 to 41 mm deep in the duff.

All of the nests used in this study were collected in Crawford and Oscoda counties. The vegetation and soil surrounding some of the nests were also collected. These samples indicated that no specific type of vegetation, other than a sizable clump of grass or small shrubs, was consistently used for concealment of the nest. Vegetation was completely arched over some nests thus permitting entrance from only one side.

The average dimensions of the Kirtland's Warbler nests were as follows: Outside diameter, 104 mm by 96 mm; inside diameter, 61 by 56 mm; outside depth, 48 mm; inside depth, 34 mm. The average thickness of the walls was 40 mm, and that of the nest bottom 14 mm. The rim was often asymmetrical and sometimes as much as 15 mm thicker than the rest of the nest wall (Fig. 1). The average weights of the dried nests was 13 grams. The construction varied as to its sturdiness. Some nests were loosely made, others tightly so. A few nests had thin places in the sides through which light passed (see Mayfield, pp. 74 and 75).

There were three recognizable layers in most of the nests (Fig. 1): (1) A loose outer layer made up of coarse stems, leaves, and rootlets of *Carex pensylvanica*, some grasses, leaves, pine needles, and a few short sticks; (2) a middle layer of more tightly woven finer grasses; and (3) the inner layer or lining that was usually of deer hair, mosses, fine twigs, or an unidentified black fiber.

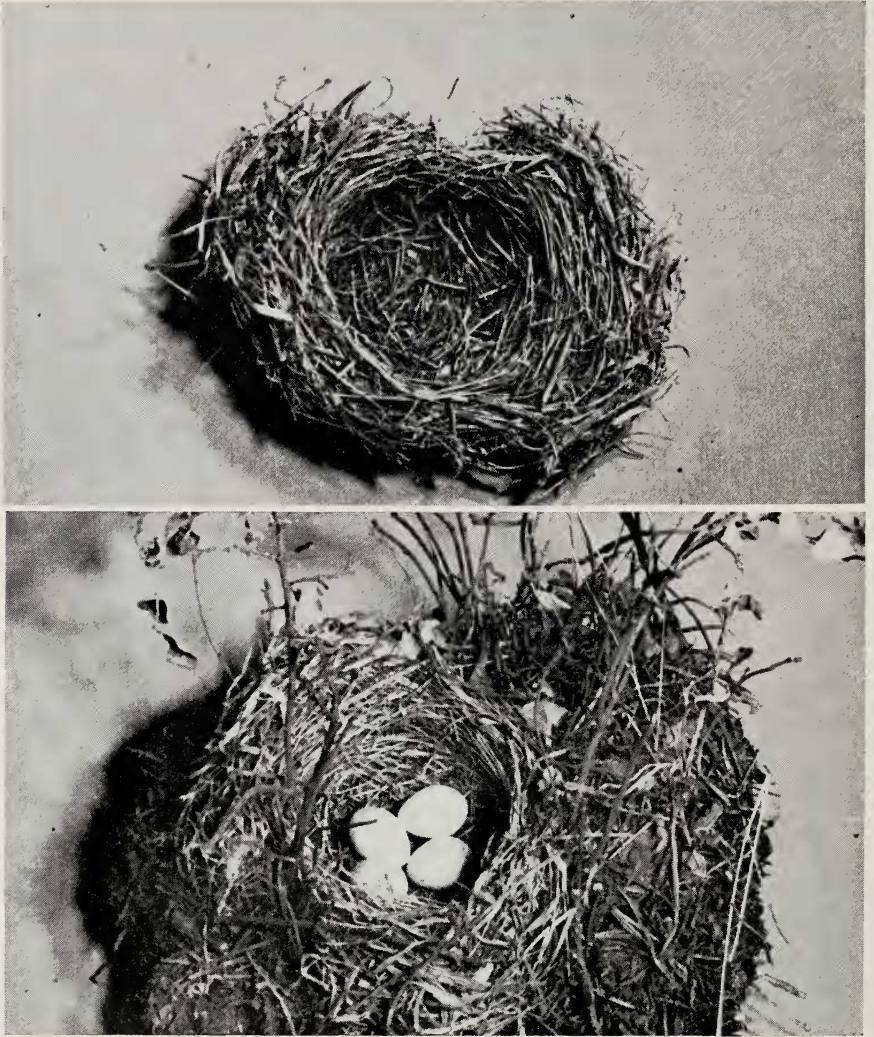


FIG. 1. Rims of nests were asymmetrical, thickened, and composed of coarser material.

At least 29 species of plants were used in the nests. Most of the species used were fairly common within the burns or savannas but none was peculiar to the pine plains.

I placed the materials found in the nests into 11 categories listed below; under each category are the species of plants included, part of the plant used, range of amounts used per nest, average lengths of the pieces, and the percentage of nests containing each type of material. The relative abun-

dance in the region (Zimmerman MS) of each species of plant used by the warblers is also given. A table summarizing the following data appeared in Mayfield's monograph (op. cit.).

COARSE GRASSES AND SEDGES.—These materials were the bulk of the outside layer of all nests. Amounts ranged from 60 to 97 per cent (av. 56.34 per cent) of the total weight of the nests. Lengths of five leaves selected at random from each of 10 nests ranged from 72 to 170 mm (av. 124 mm). The average width of the pieces was 1.6 mm.

Carex pensylvanica.—Present in 12 nests; the basal tufts were commonly used and perhaps many leaves were present, but positive identification was impossible. Zimmerman gave the constancy (percentage of times found in his quadrats) for burns as 100 per cent, and savannas 94 per cent.

Agropyron sp.—Leaves and stems of this grass were used in at least four nests. It is apparently rare within the pine plains but may be fairly common along roadsides.

Sorghastrum sp.—Leaves and stems present in one nest. Constancy 20 per cent in savannas, 9 per cent in burns. According to Zimmerman, *Sorghastrum* occurs very rarely in forest openings and not at all in shaded woodlands.

Agrostis scabra.—Leaves, stems, and some fruiting bodies used in one nest. Constancy in burns 27.2 per cent, savannas 7.9 per cent.

Eragrostis spectabilis.—Leaves were used in two nests. This grass provided surrounding cover for at least one nest. Zimmerman does not list it for the pine plains.

Andropogon sp.—Leaves and stems used in two nests. Zimmerman found two species on the pine plains, *A. gerardi* and *A. scoparius*. Respectively, their constancies are, burns 54 per cent, interior savannas 50 per cent, peripheral savannas 16.6 per cent; burns 90.9 per cent, and savannas 94.0 per cent.

FINE GRASSES.—These were the major constituents of the middle layer and, to a lesser extent, the lining of 22 (88 per cent) of the nests. Amounts ranged from a trace to 30 per cent (av. 9.85 per cent) of the total weight of a nest. Fruiting bodies, leaves, and stems were used. Lengths of the stems used ranged from 94 to 178 mm (av. 141 mm).

Deschampsia flexuosa.—Found in five nests. Constancy in burns 27.2 per cent, savannas 18.0 per cent.

Muhlenbergia glomerata.—Identified from three nests. Considered to be rare in the pine plains. Zimmerman collected it in a single Oscoda County savanna.

Agrostis scabra.—Used in middle layer and lining of 11 nests as well as in outer layers as mentioned previously.

Danthonia spicata.—Present in three nests. Constancy 63.6 per cent in burns, 82.0 per cent in savannas.

Poa compressa.—Occurred in five nests. Constancy in burns 63.6 per cent, savannas 32 per cent. Zimmerman also listed *P. pratensis* for one small area of the pine plains.

Oryzopsis asperifolia and *O. pungens.*—One or the other occurred in five nests. The first is considered generally rare by Zimmerman. The latter is much more common; constancy 54.5 per cent in burns and 16 per cent in savannas.

Festuca saximontana.—Identified from three nests. Constancy 9 to 10 per cent in burns and savannas. *F. scabrella* was also listed by Zimmerman and has a very similar constancy. However, it seems to be limited to more open areas. There is still the possibility of confusion of specimen material.

PINE NEEDLES.—Needles were found in every nest examined. Although needles were scattered through parts of all layers of some nests, the greatest percentage was usually in the outside layer.

Pinus banksiana.—Needles occurred in 25 (100 per cent) of the nests. Amounts ranged from 0.1 to 9.0 (av. 2.22) per cent of the total weight. Needles were found in all parts of the nests but were most abundant in the outer layer.

Pinus resinosa.—Needles occurred in 5 (20 per cent) of the nests. The amounts ranged from a trace to 1.5 per cent (av. 0.41) of the total weight. The needles were scattered through the outer portions of the nests but never occurred in the middle layer or lining. This species of pine occurred in 14.3 per cent of Zimmerman's quadrats. Zimmerman studied one nest of the Kirtland's Warbler from a stand of *P. resinosa* and found that needles of this species made up 30 per cent of the outer layer of the nest.

MOSESSES.—The reddish-brown sporophytes of *Polytrichum piliferum* occurred in the linings of 22 (88 per cent) of the nests studied. Vegetative portions were occasionally found in other layers of the nest. Amounts ranged from a trace to 8.5 per cent (av. 2.55 per cent) of the total weight of the nests.

TWIGS.—Fine brownish stems of *Polygonella articulata* are included under this category. *Polygonella* occurred in 9 (36 per cent) of the nest linings. Amounts ranged from 0.8 to 9.9 (av. 1.8 per cent) of the total weight. On no occasion were both *Polytrichum* and *Polygonella* present in a nest lining. Constancy of *Polygonella* was 9 per cent in burns and 14 per cent in open savannas. It was more common along roadsides. Stem lengths ranged from 56 to 61 mm (av. 58 mm).

Coarser twigs were found in outer portions of 18 (72 per cent) of the nests. Pieces were usually short and dark in color. Diameters ranged to 4 mm. Amounts per nest ranged from 0.1 to 5.7 (av. 1.55) per cent of the total weight. The following woody plants were represented: *Quercus* spp., *Pinus banksiana*, and *Vaccinium angustifolium*. Lengths ranged from 16 to 52 mm (av. 33 mm).

LEAVES.—Leaves of deciduous trees, shrubs, and herbaceous plants occurred in 20 (80 per cent) of the nests. Amounts ranged from a trace to 4.3 (av. 1.27) per cent of the total weight. Small leaves or portions of larger ones were used. Plants represented were *Quercus* spp., *Salix* sp., *Vaccinium angustifolium*, *Comptonia peregrina*, *Prunus* sp., *Arctostaphylos uva-ursi*, and *Epigaea repens*.

ROOTLETS.—Relatively unimportant amounts of small rootlets were found in 9 (36 per cent) of the nests. Amounts ranged from a trace to 2.25 (av. 0.41) per cent. Rootlets were present in nest linings. Generally only one or two pieces, if any, were found per nest.

LICHENS.—Small amounts of *Cladonia* spp. ranging from a trace to 1.5 (av. 0.55) per cent occurred in 9 (36 per cent) of the nests studied.

BLACK FIBERS.—Fibers occurred in 8 (32 per cent) of the nests and ranged from 0.69 to 5.7 (av. 1.5) per cent of the total weights. Lengths ranged from 49 to 111 mm (av. 70 mm). The fibers were long, twisted, and had minute side branches. Chemical preparation and microscopic examination showed that each strand was composed of numerous fine fiber-tracheids. The strands could possibly be from a variety of plants. Superficially the material resembled the core from Spanish moss (*Tillandsia usneoides*) which, of course, does not occur in the area. Most of the nests that contained these fibers were from Crawford County. The fibers were used only in nest linings. Usually no hair and few mosses were used when moderate or large quantities of fibers were used.

DEER HAIR.—Hair was the predominant material used in nest linings. Twenty-one nests (84 per cent) contained white deer hair (*Odocoileus virginianus*) in amounts ranging from a trace to 2.9 (av. 1.14) per cent of the total weights. A combination of mosses and hair was most commonly used in the lining. One or two nests contained a few strands of hair from other mammals.

MISCELLANEOUS.—Included under this heading are four types of materials.

One or two small feathers occurred in 3 (12 per cent) of the nests. All were apparently passerine feathers, possibly those of the Kirtland's Warbler.

Wood chips were found in 3 (12 per cent) of the nests. Amounts ranged from 1.5 to 8.8 per cent. One nest contained numerous light, sizable chips, apparently the remains of woodpecker workings.

Equisetum was found in 2 (8 per cent) of the nests. One nest contained a single short piece of the fruiting stalk of *E. fluviatile*. Another nest contained a relatively large amount (by bulk), 7.2 per cent by weight, of the vegetative portions of probably *E. sylvaticum*. These pieces ranged from 69 to 133 mm (av. 104 mm) in length.

Houstonia longifolia appeared in one nest (4 per cent). A small piece of fruiting material was found in the outer layer.

DISCUSSION

As a result of this study it is possible to conclude that nest materials are not distinct limiting factors for the distribution of Kirtland's Warbler. None of the plants identified from nests was restricted to the pine plains. Many probably occur in more dense forest stands and other jack-pine regions not inhabited by Kirtland's Warbler. However, a broader view suggests that the plants most commonly used in nests are characteristic of associations, within the pine plains, preferred by the warblers. Examination of areas that appear suitable, to us, as warbler habitat might actually show an absence of some of these important plants, thus making the area uninhabitable to the birds. This could also be one reason for the nearness of pairs within some areas rather than the birds being dispersed throughout the apparently available habitat. It is also apparent that the importance of particular species of sedges and grasses must be considered, not only with regard to the amounts used in the nests, but with consideration of their abundance in the area. With this in mind we can see that the grasses play an important dual role (1) by providing the bulk of the nest materials, and (2) by providing the major type of concealment for nests. When we consider these two points together it is obvious that the part played by these plants may indeed be important in restricting the warblers to the open, savanna-type or recently burned jack-pine areas.

Although some materials, or species of plants, appeared to be used in very small amounts (by weight) their appreciable bulk contributed significantly to the nest (e.g., deer hair, black fibers, *Equisetum*). Also some small, light-weight materials (e.g., moss sporophytes) probably required more trips by the birds to supply the amounts used in nest linings and their importance should be evaluated with this in mind.

A combination of many factors is probably responsible for the restricted range of Kirtland's Warbler. Eventually we may be able to amass all of the evidence and understand the ecological requirements of the species.

SUMMARY

1. Twenty-five nests of the Kirtland's Warbler were examined; 20 were taken apart and the materials identified, weighed, and measured.

2. The prevalence of "pine islands" is apparently necessary for the presence of breeding Kirtland's Warblers.

3. The nest is located on the ground near jack pines.

4. The nest was composed of three layers of noticeably different materials.

5. Twenty-nine species of plants were identified from nest contents. Most of these were fairly common in the pine plains.

6. The materials used in the nests were placed in 11 categories, and each species of plant is discussed as to the amounts and portions used in the nests, position in the nest, and the constancy of the species in the pine plains.

7. The abundance of sedges and grasses may be important in restricting the warblers to particular portions of the jack-pine plains. There was no indication that any one particular plant affected the distribution of the warblers. However, an association of plants, represented by those found within the nests, may have a definite influence upon the selection of nesting habitat by the warblers.

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 NEW LIFE MEMBER

We welcome Harold D. Mitchell, of Williamsville, New York, as a new life member of the WOS. A graduate of MIT, Mr. Mitchell is a retired sales engineer spending more time now on his special interests in bird distribution and in bird photography. He gives talks before various organizations and illustrates these talks with his own color slides and motion pictures. He has conducted classes for adults at the Buffalo Museum of Science, has published articles in *The Auk* and *The Wilson Bulletin*, and has read papers before the Federation of N.Y. State Bird Clubs and the AOU. Mr. Mitchell is an elective member of the AOU, a former president of the Federation of N.Y. State Bird Clubs, the Buffalo Ornithological Society, and the Buffalo Audubon Society, and a member of the Linnaean Society, Nature Conservancy, and several other similar organizations.

